

Force Expansion Curves

a way to model future capability

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Other authors

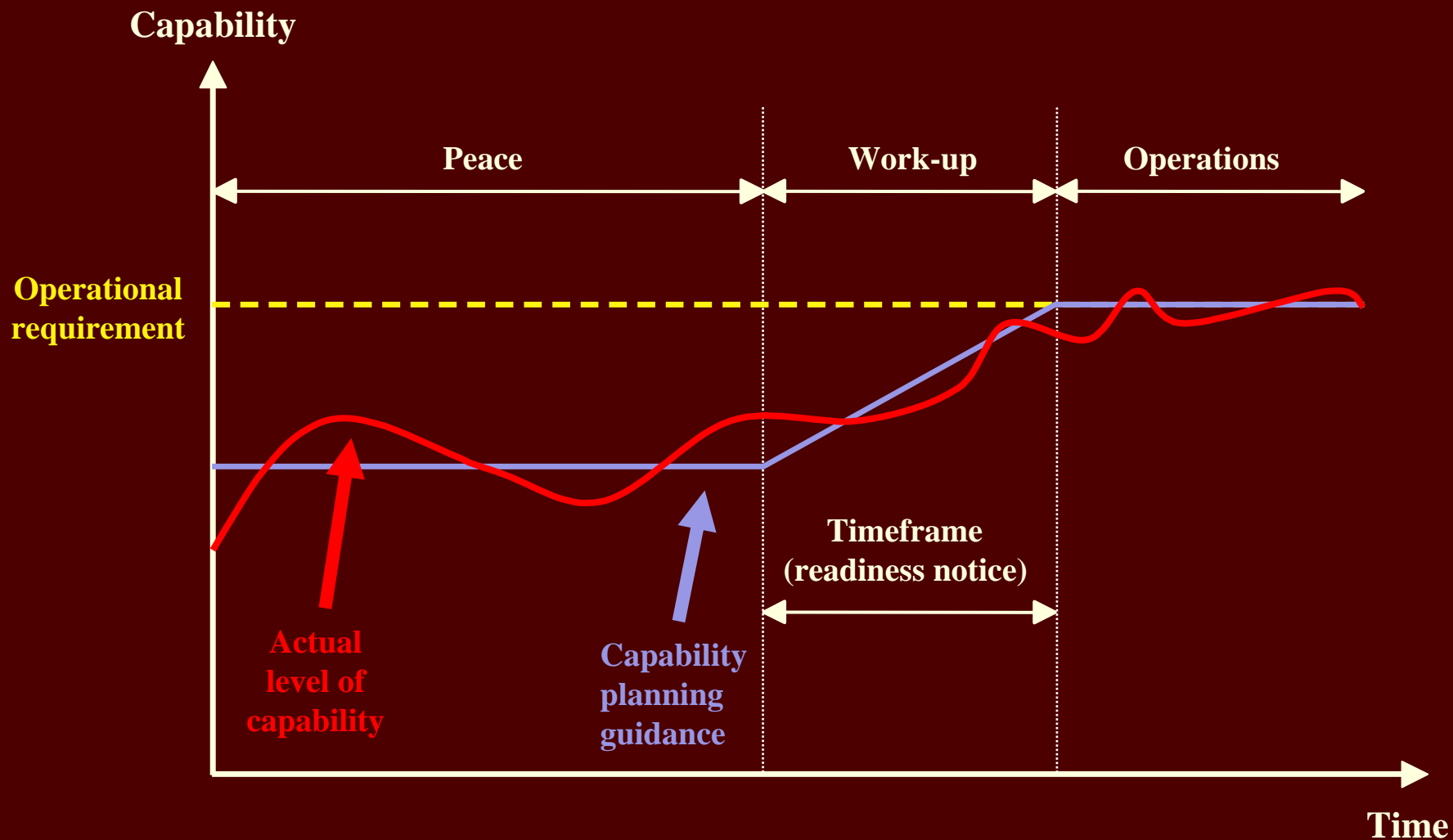
- Andrew Nicholls, Office of the Minister for Defence
- David Cox, Air Operations Division
- Richard Bartholomeusz, Air Vehicles Division

Structure of talk

- How does the ADF manage capability?
- What are Force Expansion Curves?
- Case study: Maritime Patrol Group
- How can we use Force Expansion Curves?

How does the ADF manage capability?

Levels of capability



What are Force Expansion Curves?

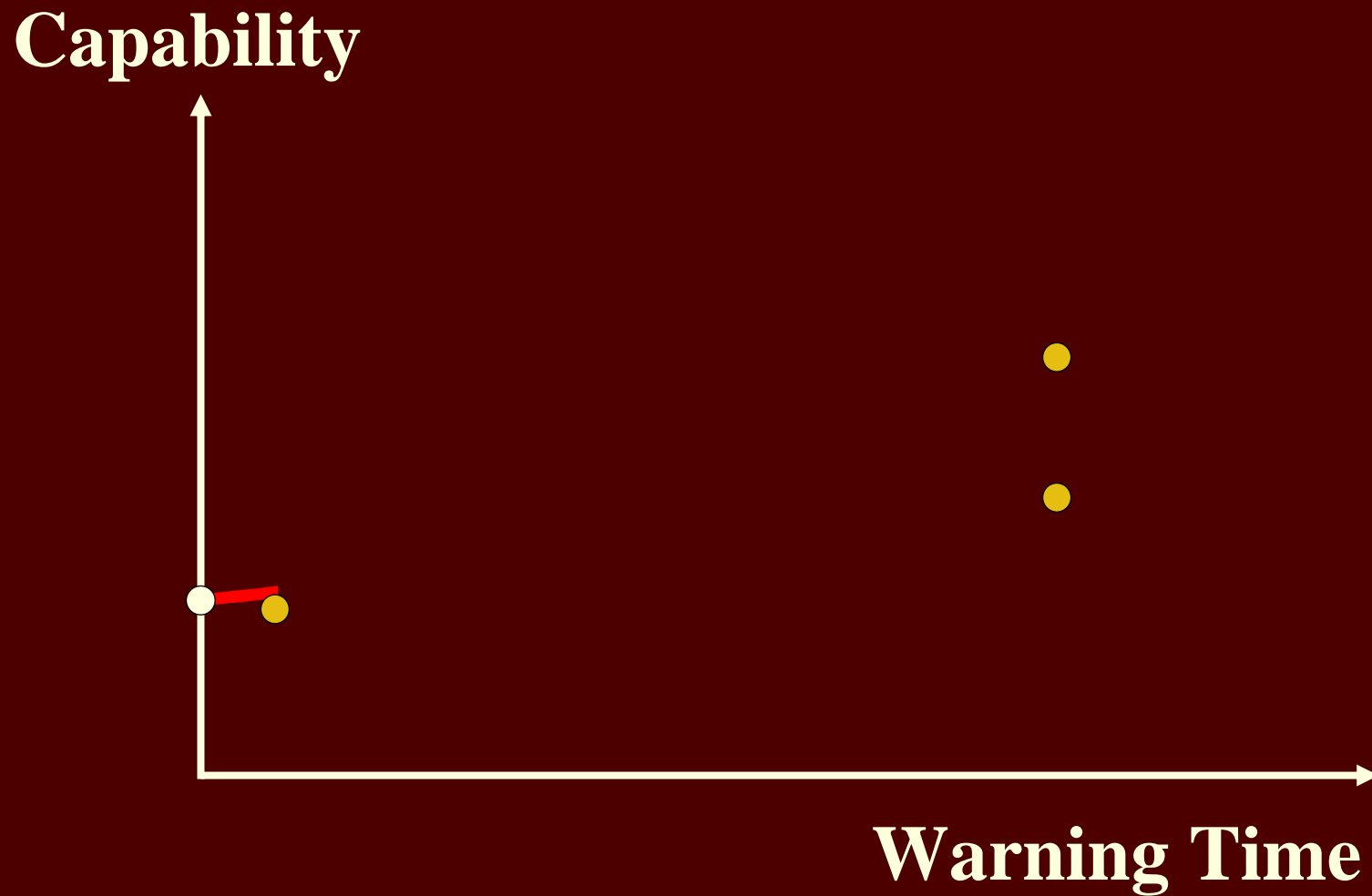


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Motivat



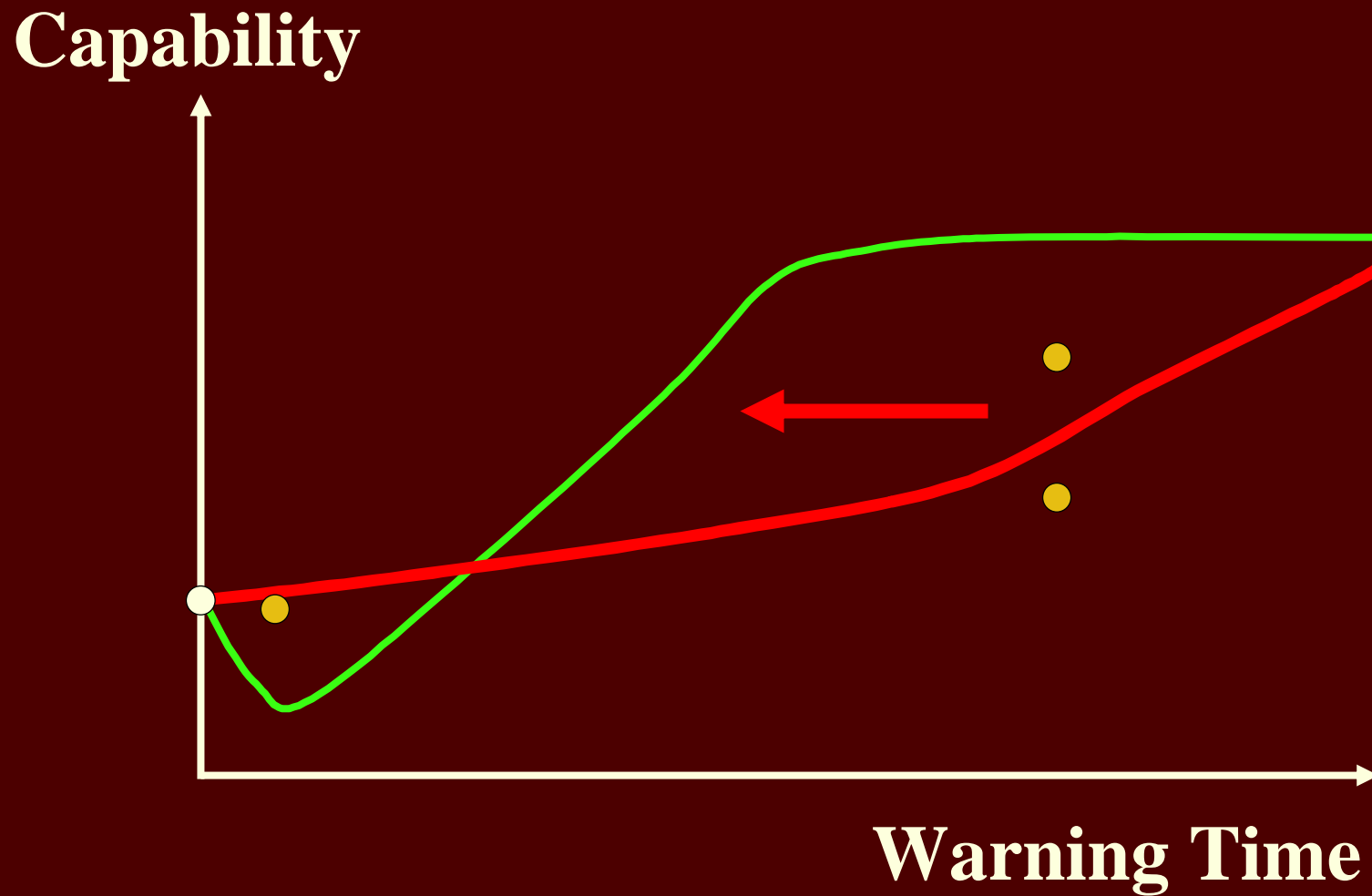
Motivating example



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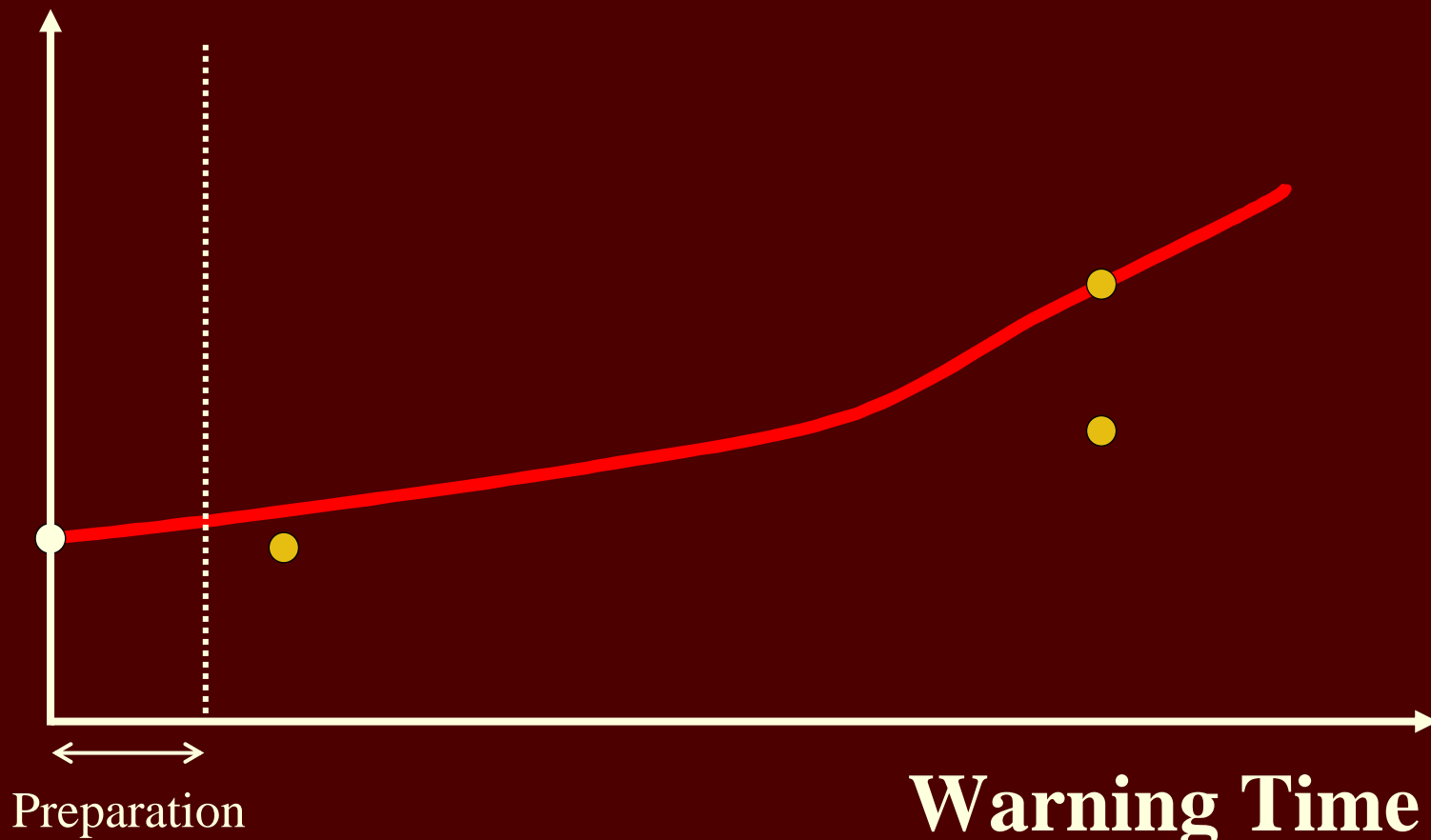


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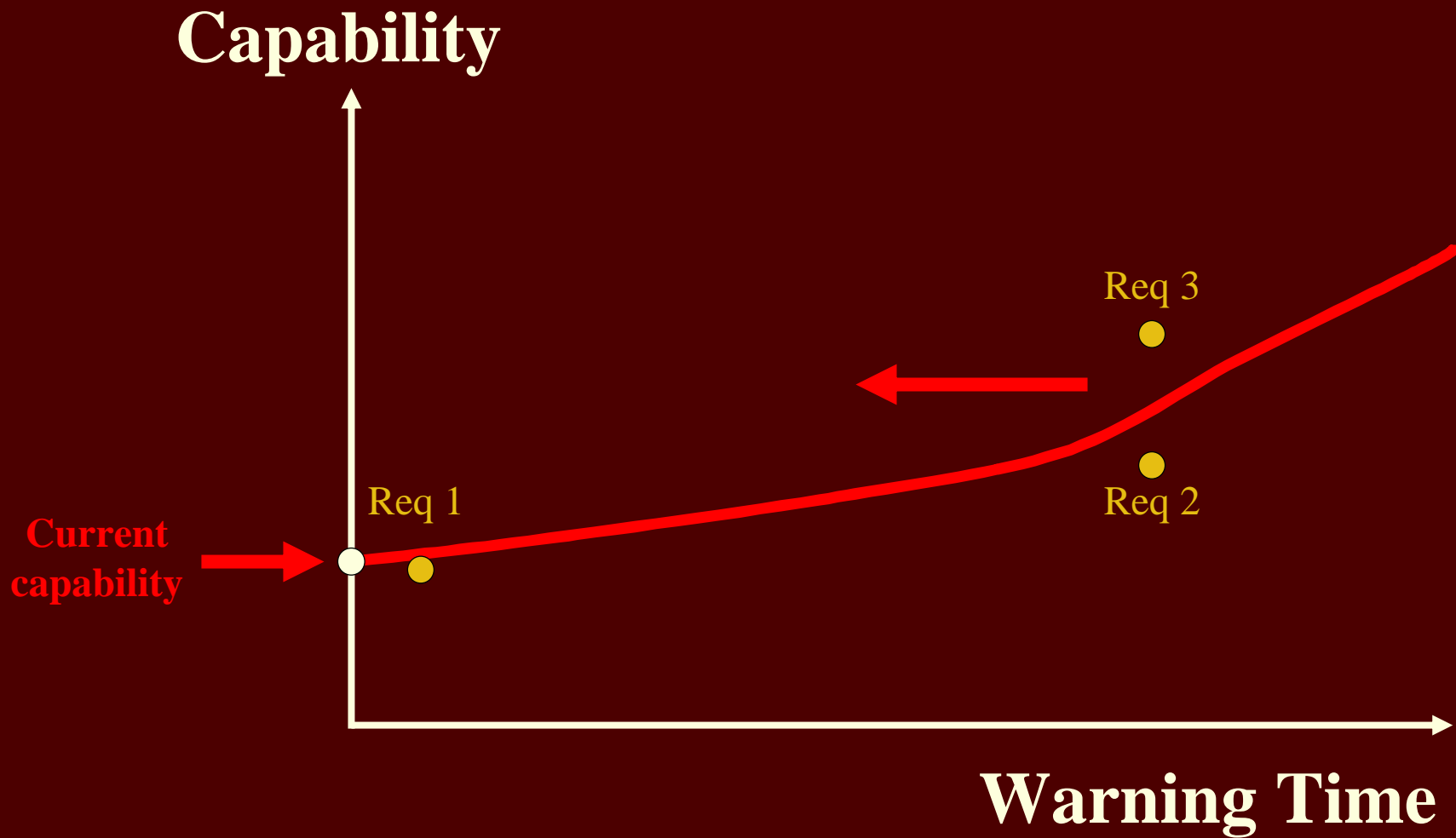


Motivating example

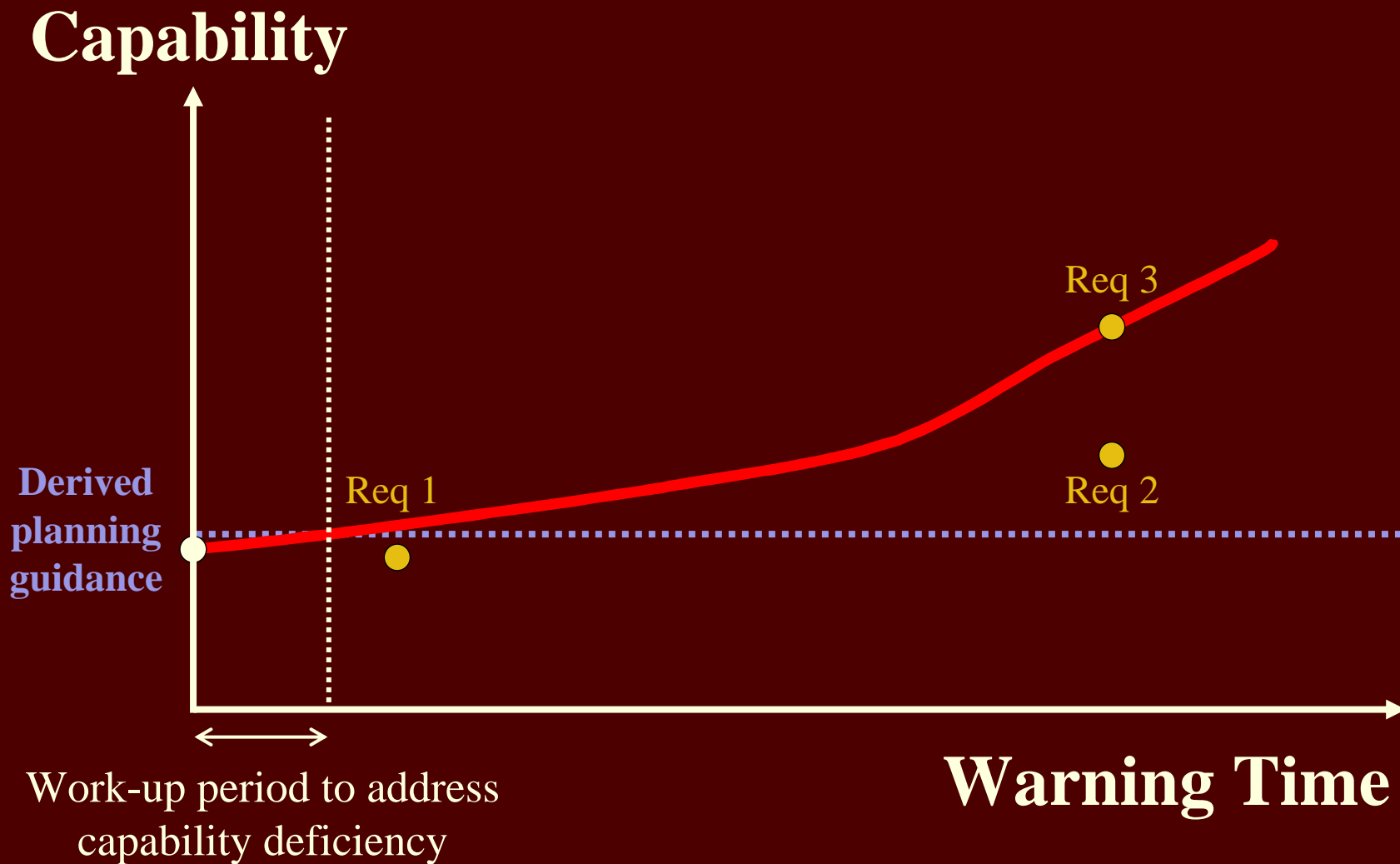
Capability



Military context



Military context



Key questions

- How do we measure capability?
- How do we interpret strategic guidance?
 - Hard constraints (optimisation)
 - Soft constraints (goal programming)
- How do we create Force Expansion Curves?

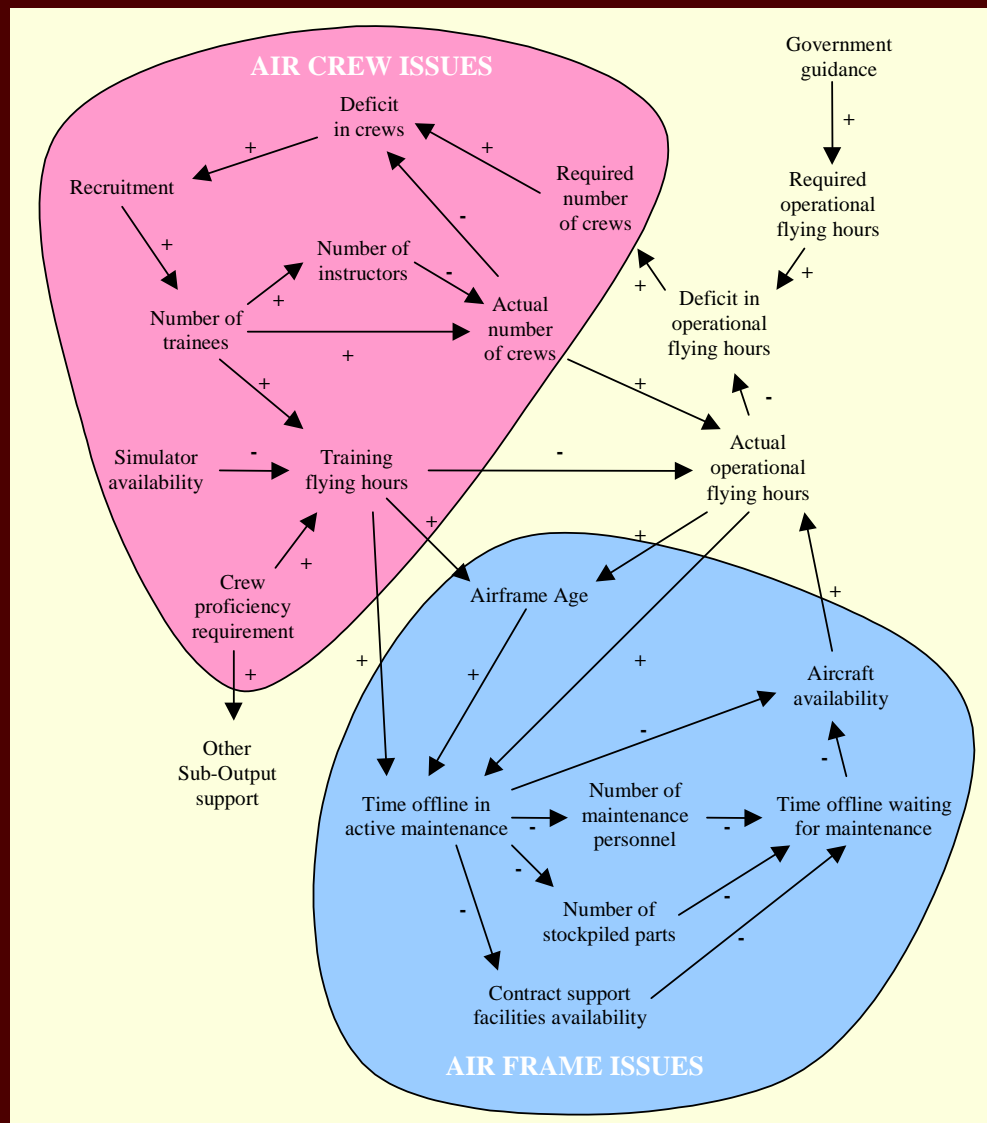
Case study: Maritime Patrol Group



Case study: Maritime Patrol Group

- In 2000, DSTO study of preparedness recommends the development of Force Expansion Curves
- Maritime Patrol Group was chosen:
 - Continuity
 - Good data
 - Enthusiasm and support

Influence Diagram



General approach

- Simulate the crew training and posting cycle

Why did we break this up
into two parts?

- Test the feasibility of the resulting flying program

Variables and parameters

- Capability measure: Number of crews
- Variables (controls):
 - Capacity of simulators
 - Number of instructors
 - Recruitment
 - Course lengths and posting lengths

EXTEND

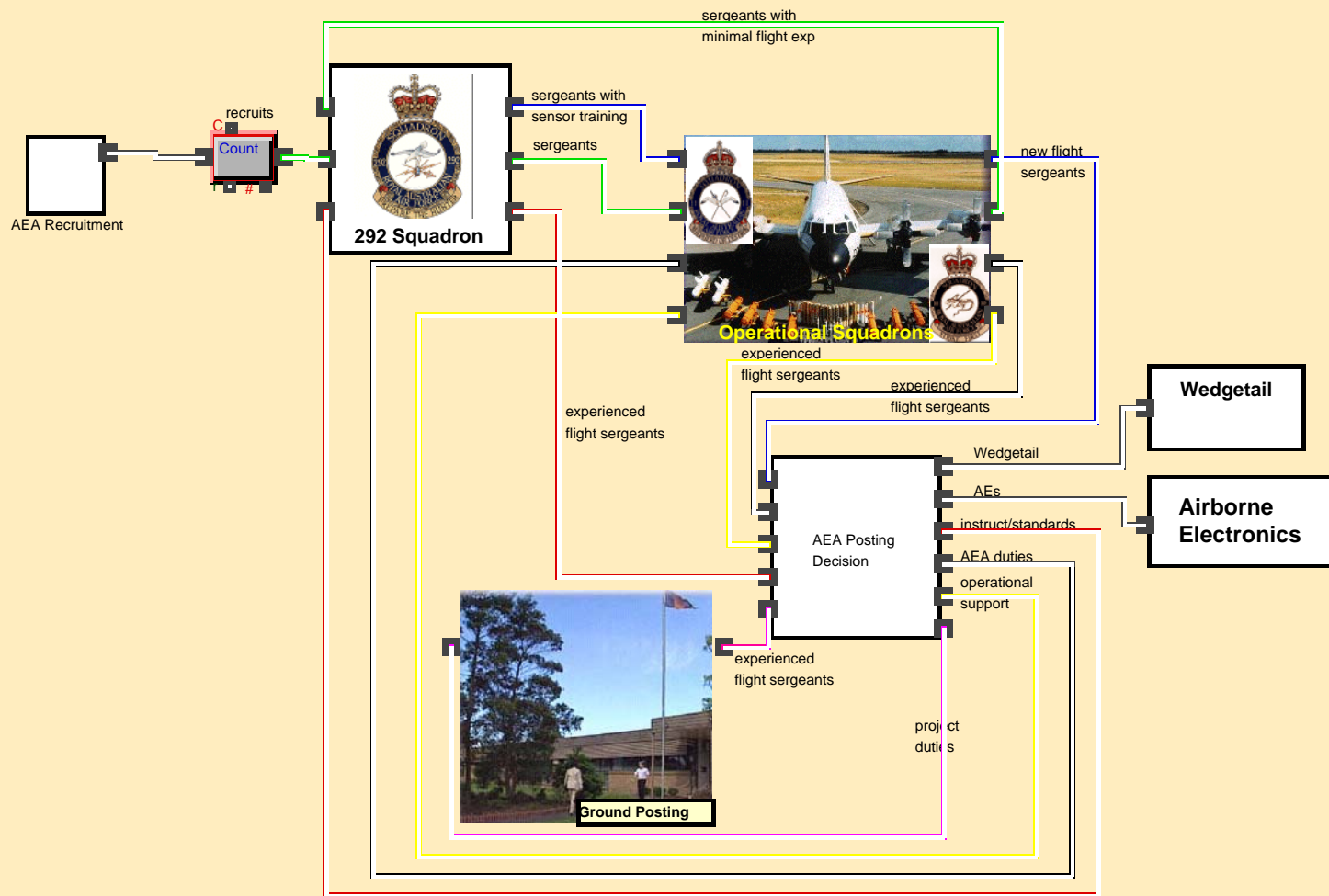
- Simulation environment
- Both continuous time and discrete event models
- Features:
 - Good graphical user interface
 - Hierarchical blocks
 - Monte Carlo simulation
 - Sensitivity analysis
 - Heuristic optimisation (genetic algorithm)
 - Compatible with MS Excel

Personnel Model

- Personnel pipelines modelled as a production line
 - People modelled as items
 - Events modelled as machines
- Current and future MPG personnel practices are included

Personnel Model

Airborne Electronic Analysts



Personnel Model

- Crew:
 - 2 Pilots
 - 2 Navigators
 - 1 Airborne Electronics
 - 5 Airborne Electronic Analysts
 - 2 Flight Engineers

Personnel Model

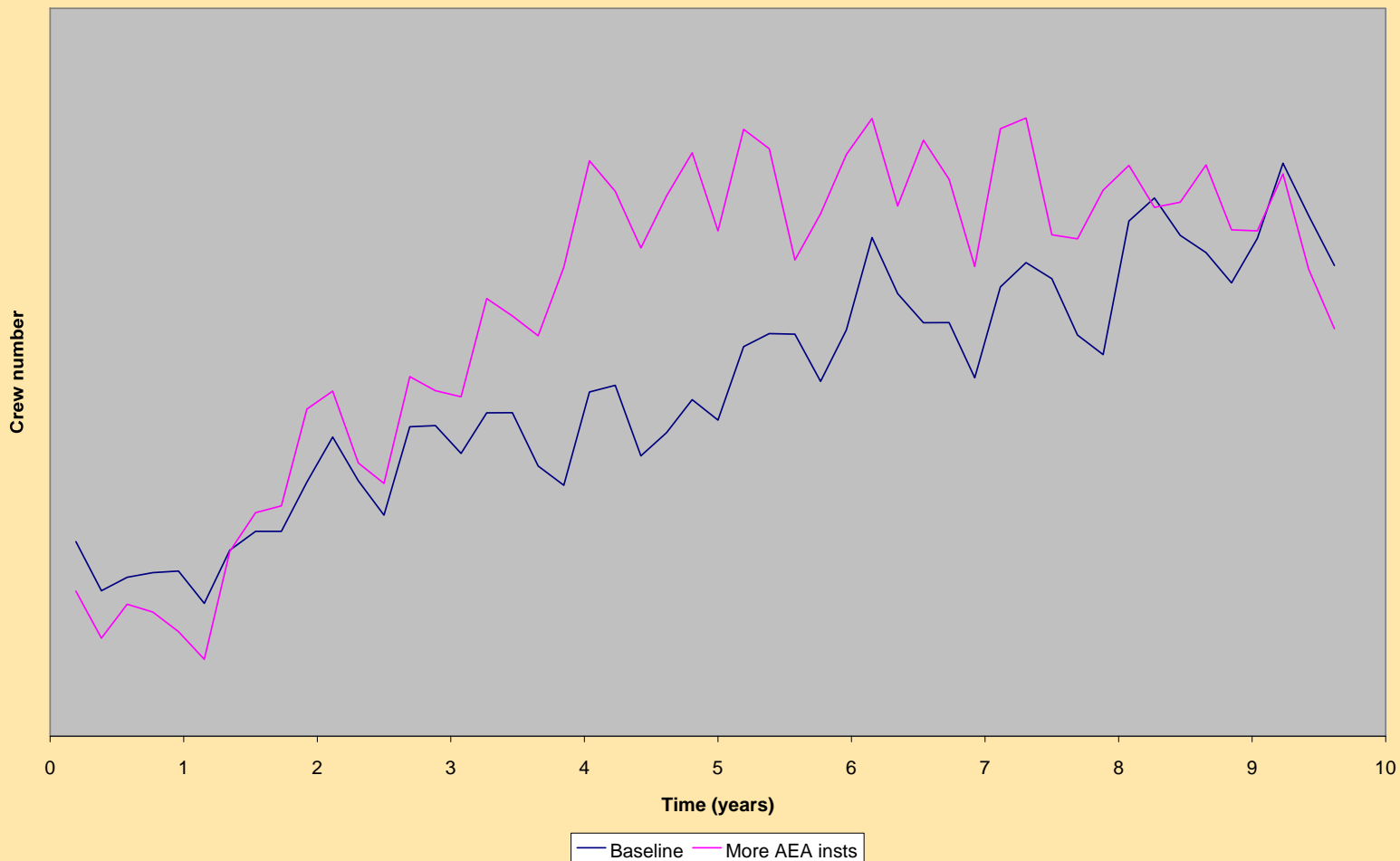
- Each role has a separate module
 - Easily understood and validated
 - Caters to time limitations
- Roles combine into crews
- Other modules:
 - Initialisation
 - Controls
 - Outputs

Personnel Model

- Predicts future crew levels
 - Baseline: current personnel practices
 - ‘What if’ analysis: altered system
- Indicates critical factors and bottlenecks

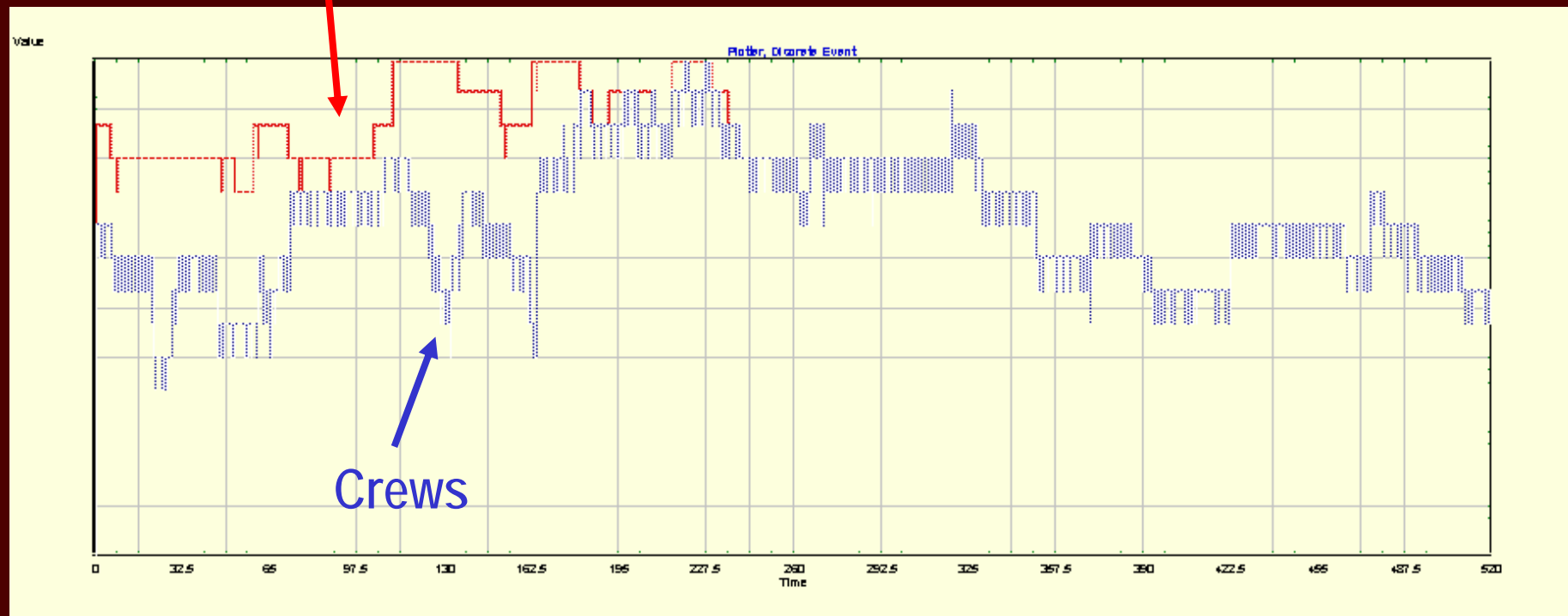
Sample Personnel Results

Sample crew expansion curves



Sample Personnel Results

Airborne Electronics

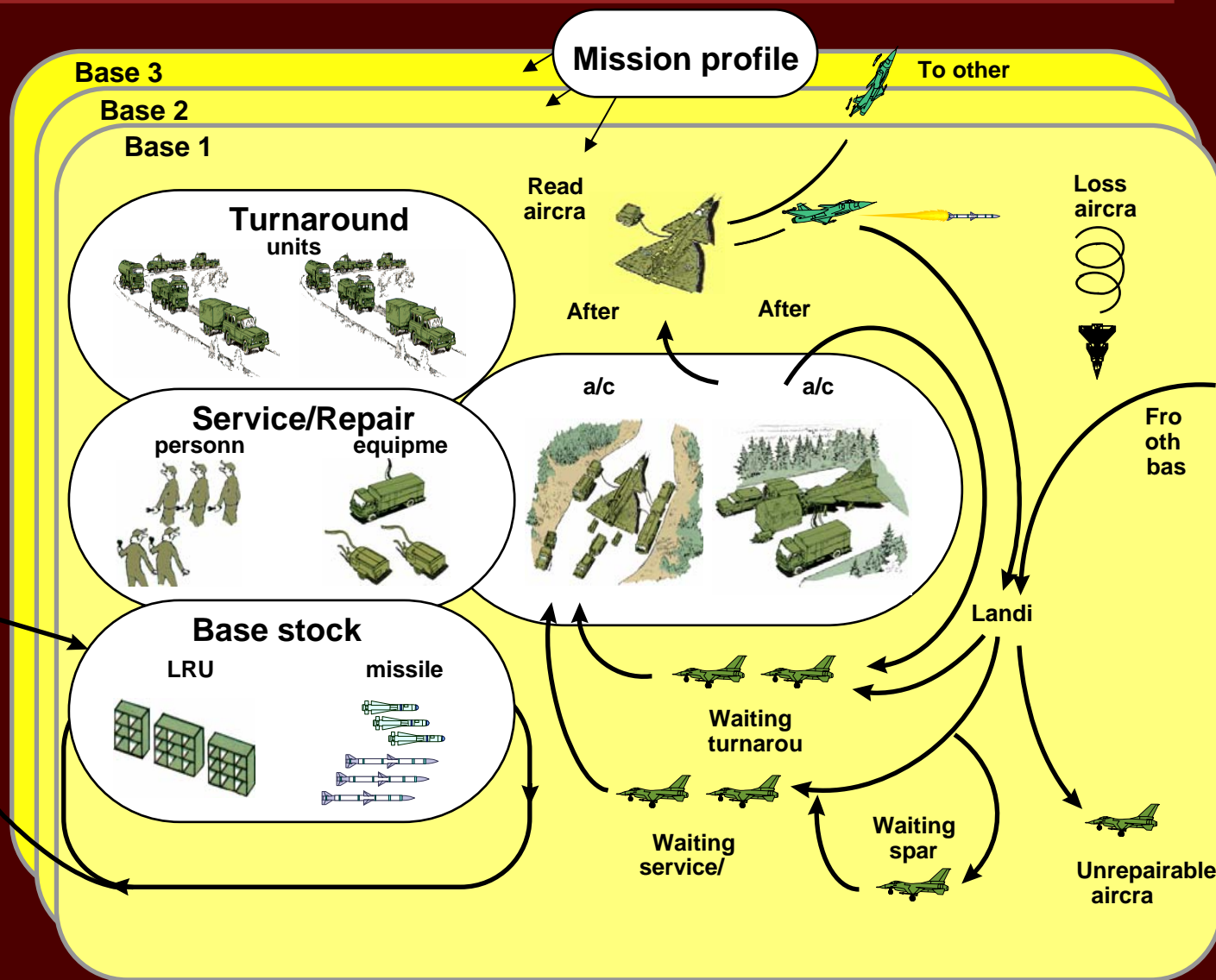


ASTOR

Air Force Simulation of Tactics and Operational Resources

- Developed by the Swedish Air Force and the RAAF
- Used by MPG to manage P-3C logistics
- Tests a predetermined flying program for feasibility
- Constraints:
 - Maintenance crews
 - Maintenance equipment
 - Spare parts
 - Aircraft reliability

ASTOR



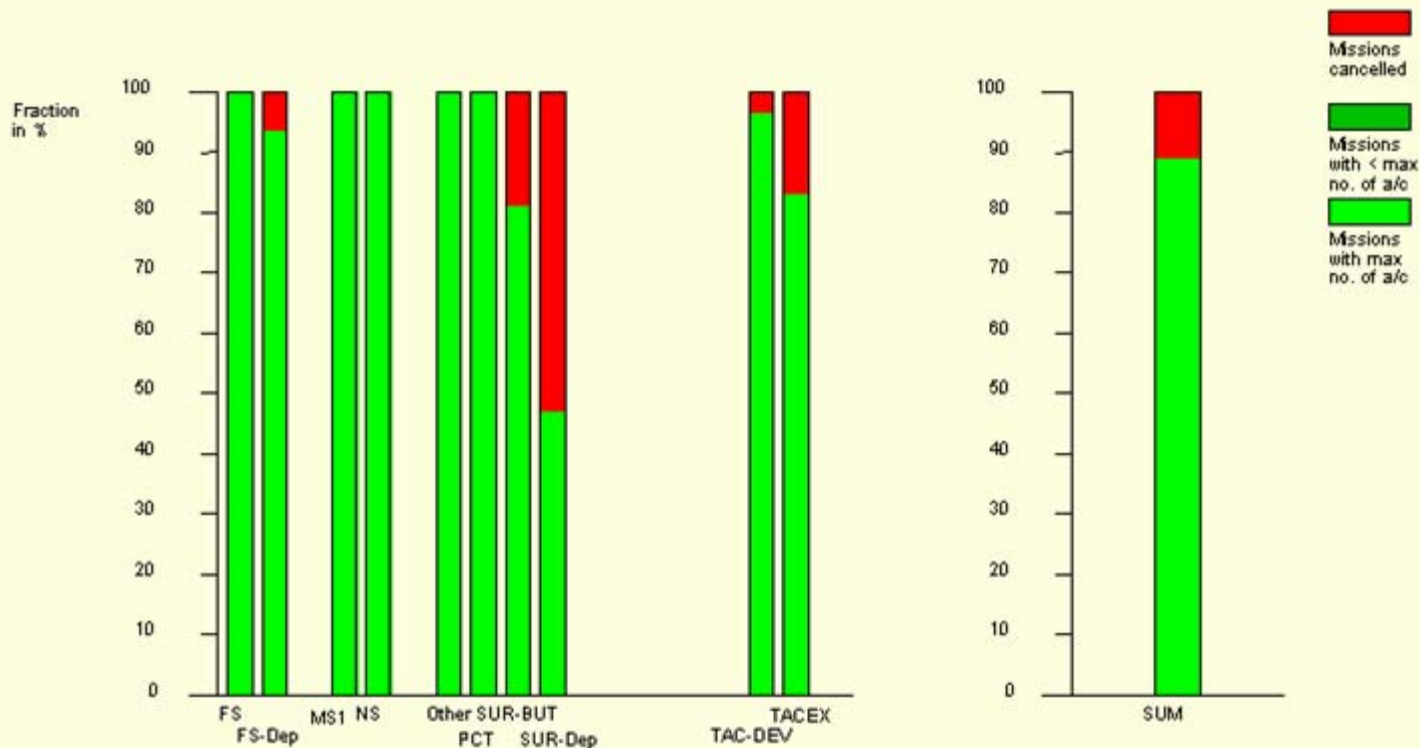
ASTOR

- Outputs:
 - Aircraft availability
 - Proportion of missions accomplished
 - Spare parts consumption
 - Repair and maintenance time

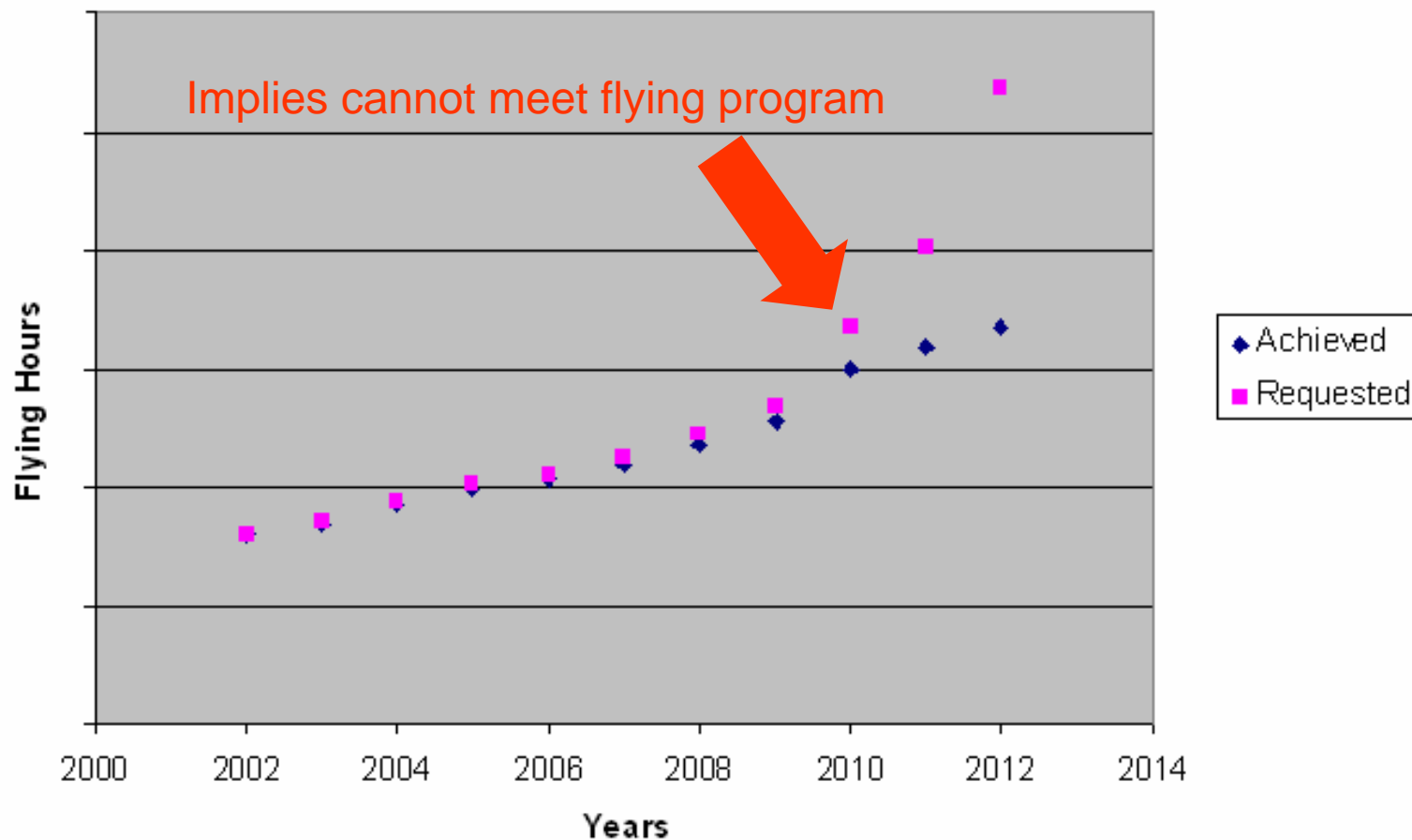
Sample ASTOR results

MISSIONS ACCOMPLISHED

Missions accomplished, fraction of ordered



Using ASTOR to Support the Personnel Model



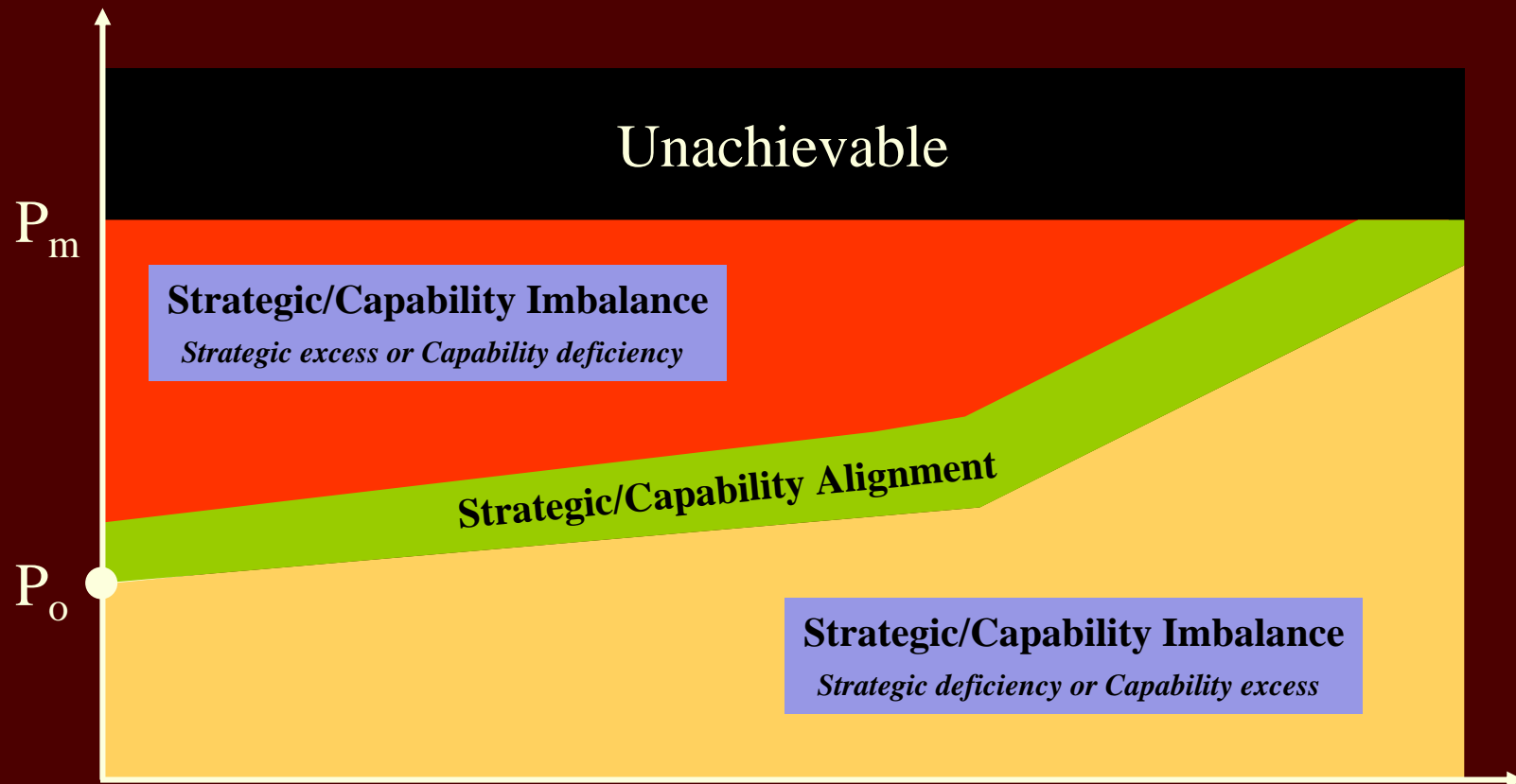
How can we use Force Expansion Curves?

Assistance to medium term preparedness planning



Assistance to medium term preparedness planning

Capability



P_o Current Capability

P_m Maximum Achievable Capability

Warning Time

Conclusions

- Force Expansion Curves can improve capability management by:
 - Illustrating different expansion strategies
 - Demonstrating rate and extent of expansion
 - Quantifying the effect of controls
 - Allowing costing of different options